



ADVANCED TECHNIQUES FOR AUTOMATED STATE-WIDE SURFACE WATER QUALITY ASSESSMENTS USING 'R'

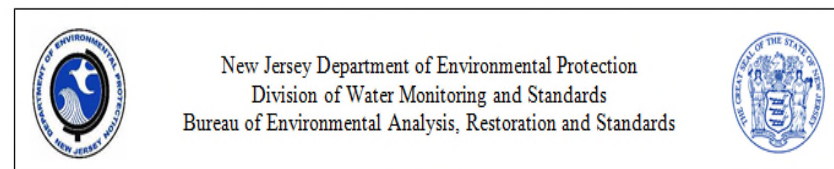
Jack Pflaumer, Roop Guha, Joseph Aiello
New Jersey Department of Environmental
Protection

Introduction

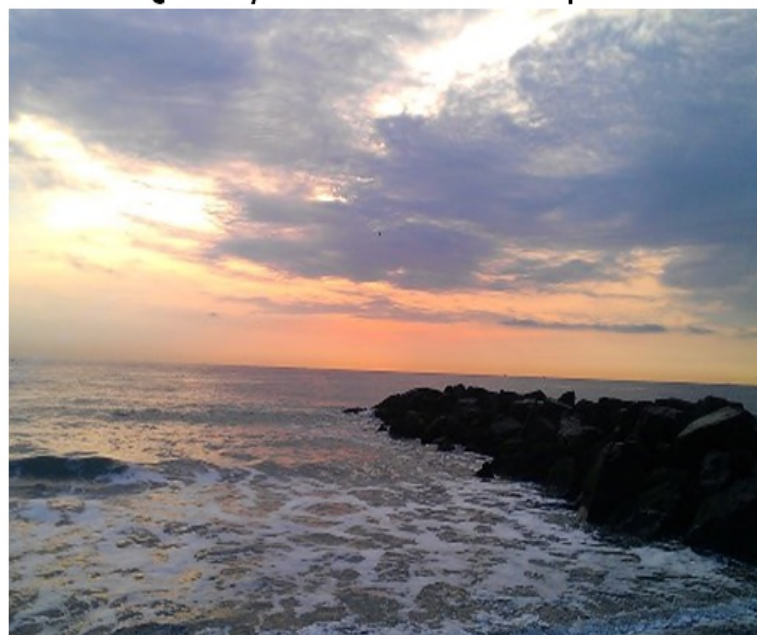
- Aspects of the process
- Automation steps
- Analysis tools developed
- Comprehensive Assessment
- Future Projects

Integrated Reporting Process

- Chemistry Data Crunching
 - 958 assessment units (HUC₁₄)
 - 5 - >10 years of data
 - > 10,000 discrete stations
 - > 3.2 million discrete data
 - > 300 continuous monitoring stations
 - > 90 parameters
 - Biological Data
- Assessments
 - Station Level
 - HUC Level chemistry and biological assessment rollup
 - Designated Use assessment



2014 New Jersey Integrated Water Quality Assessment Report



Atlantic Ocean at Rock Jetty, Long Branch, New Jersey
Photo: Courtesy of Jon Dugan (AmeriCorps NJ Watershed Ambassador)

Draft
December 2015

Process Components

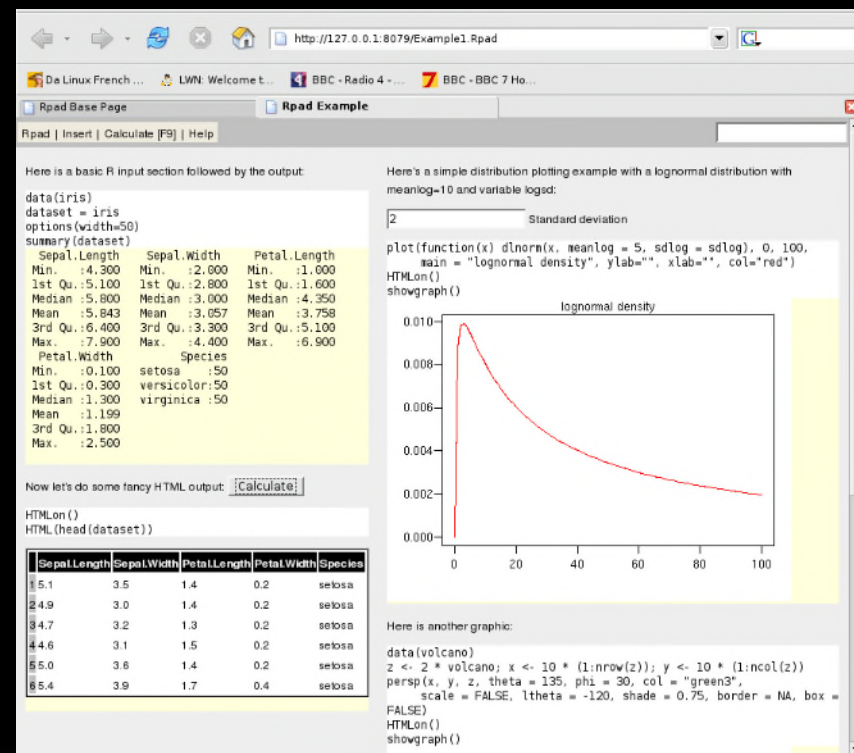
- Data solicitation
- Methods document
- Data download

- Data QA
- **Data Analyses**
- Comprehensive Assessment - Tools
- Compile tables and graphs for Report

R

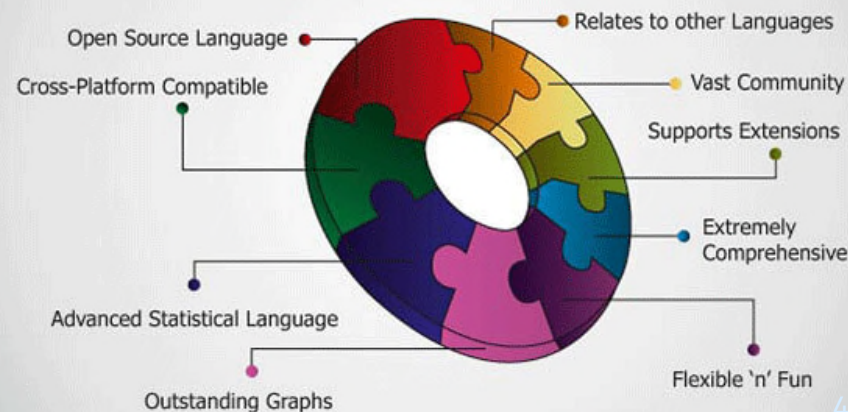
R-Shiny

- Report Generation
- ATTAINS batch files upload –
FINAL SCHEMA NOT YET AVAILABLE



Why Learn R?

edureka!



Quality Assurance Tools

- Check duplicate records – entire record, USGS duplicates (e.g. NH₃ is reported by both mg/L-N and mg/L-NH₃)
- Remove
 - Continuous data including max/min (Cont. data assessed separately)
 - Quality control data
 - Continuous records
 - Lab comments
 - Site conditions
 - Result comments
 - Data errors
 - Data without approved QAPPs
- Substitutes censored data
- Normalizes reporting units and parameter names
- Flags preliminary and estimated data

A	B	C	D	E	H	L	M	N	O	P	Q	R
orgid	actid	actyp	stdate	sttime	locid	metcont	metnam	detcond	charnam	samfrac	val	valunit
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31DELRBC	31DELRBC_WQX-1008	Field Msr/l	8/30/2010	10:23:00	31DELRBC_WQX-892065	USEPA	USEPA		Dissolved oxygen (DO		7.01	mg/l
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Analysis Tools

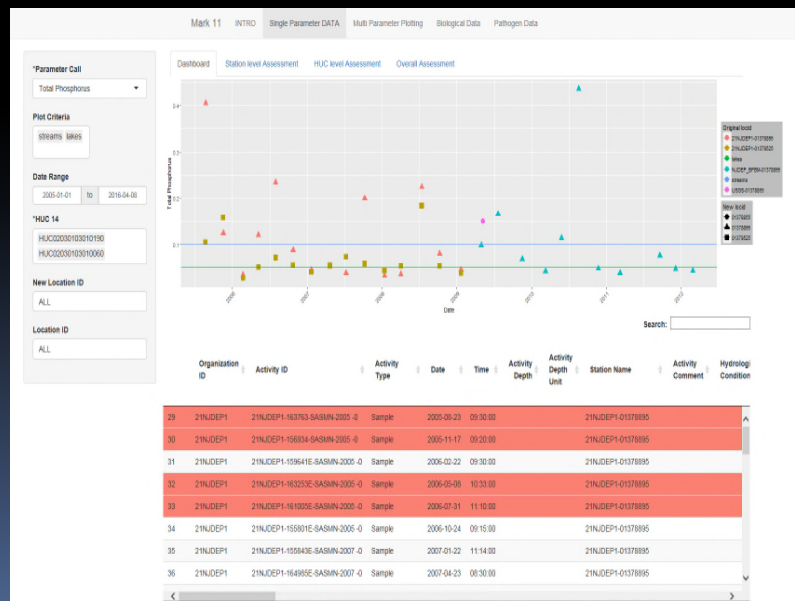
- Preliminary manual-work to update lookup tables
 - Station – classifications, stations' groupings, stations HUC associations
 - Parameter – criteria tables
- Discrete chemistry and pathogen
- Continuous monitoring
 - NJDEP data from Rutgers University website
 - USGS data from USGS directly
- Compile chemistry (discrete and continuous), biological, pathogen at data level, station level and AU level



History of Automated Assessment Process

- Incremental improvements to automation process
- Excel (pre-2006)
- Access (2006)
- R (2016)

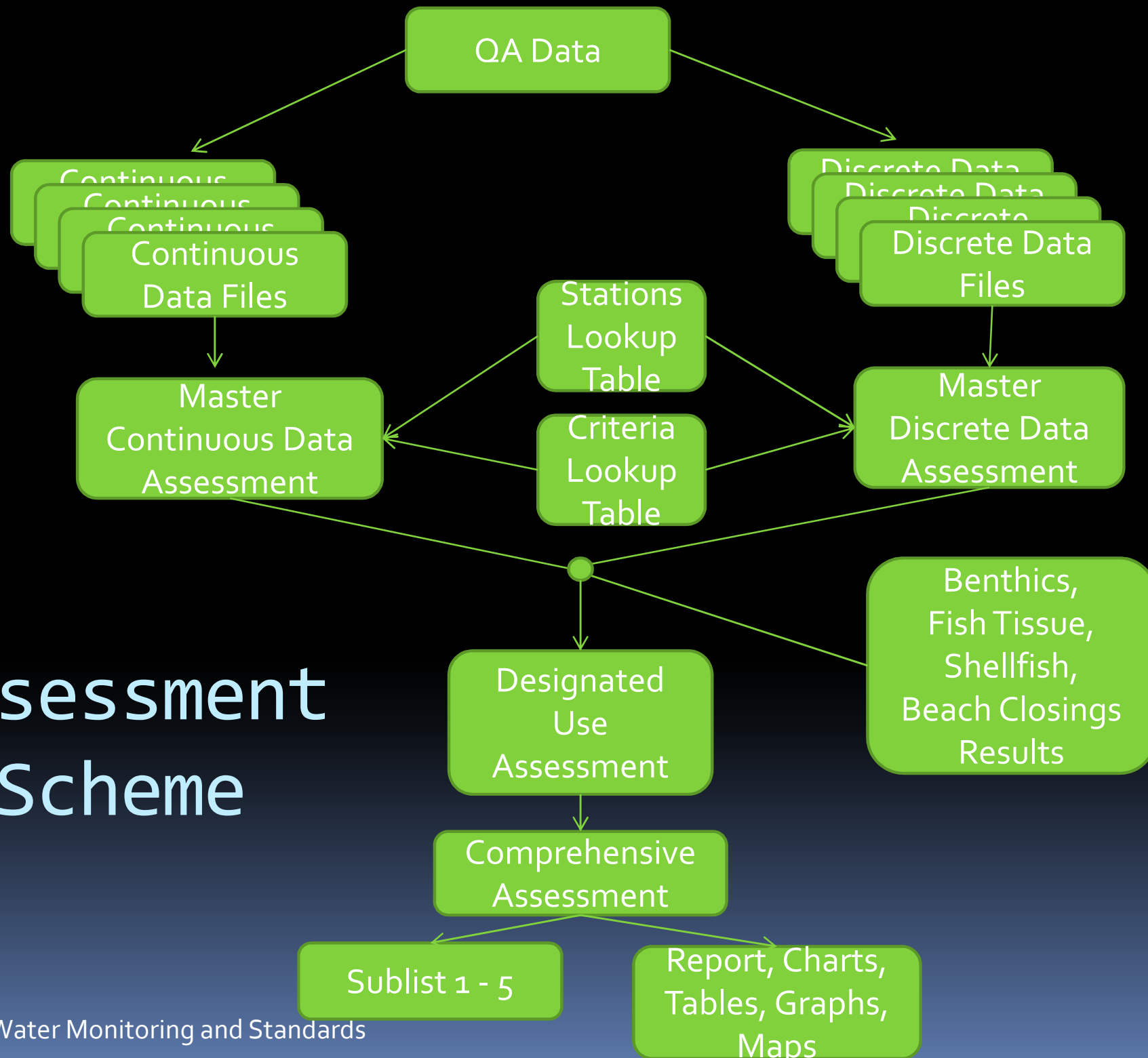
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Benefits

- Improved efficiencies
- Stronger confidence in analysis
- Improved validation process
- Improved assessment and statistical analysis
- Improved visual representations
- Easy to learn, flexible, and expandable
- Some functions already created
- Overall improved transparency of process

Assessment Scheme



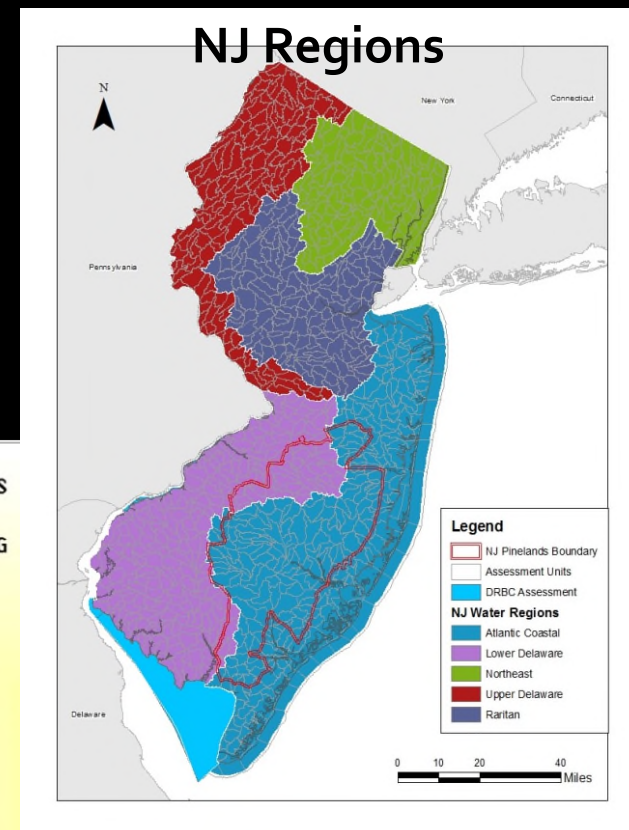
Data Level Assessment

- What is an exceedance at this level?
- Most straight forward process – comparison to criteria
- Criteria based on water classification
- Discrete
 - Pathogens – geomean, SSM
 - Metals – hardness dependent equations
 - Toxics – HH criteria, AQL criteria, carcinogen, noncarcinogen
 - Unionized Ammonia – pH, temperature dependent equation and season
 - Biological – Index of Biological Integrity or Biological Condition Gradient
- Continuous
 - DO, temperature, pH, turbidity, nitrate only
 - 30 day average, 7 day average, 24 hr average - rolling averages
 - 24 hour time frames, 1 hr minimum for an exceedance

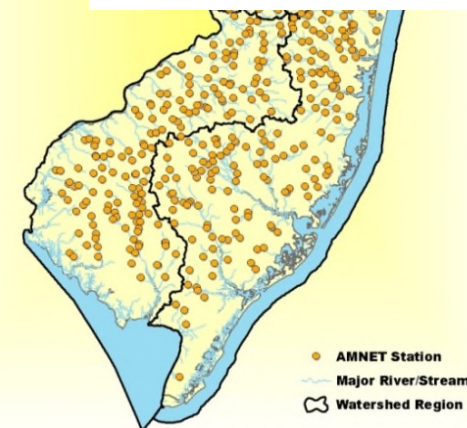


Station Level Assessment

- Assessment Method
 - Data Requirements
 - Discrete vs Continuous
 - Grouping of Stations
 - Number of exceedances
- Focus on one of five Water Region each listing cycle
 - 5 yrs or 10 yrs of data assessed
- DDPLY Function in PLYR package very useful
 - 5 yr, 10 yr results
 - Number of stations
 - Number of samples
 - List of data values
 - Number of exceedances, percent exceeds
 - Min/Max values
 - Flags indicating estimated/preliminary data
 - Identify high or low exceedance pH only
 - Flags stations in focus region-checks for data requirements
 - Flags results for validation actions
 - Initial assessment, final assessment
 - Compares previous data results and notes

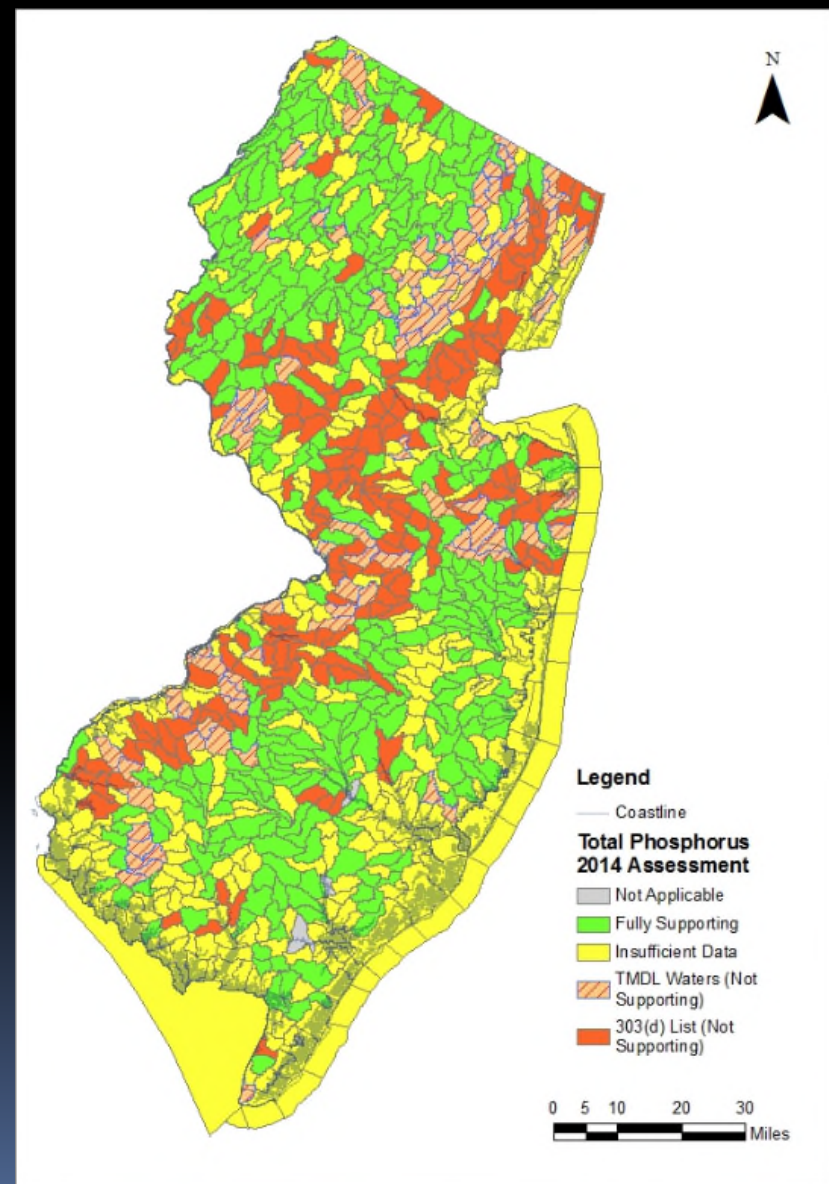


NEW JERSEY'S
AMBIENT
BIOMONITORING
NETWORK
2012



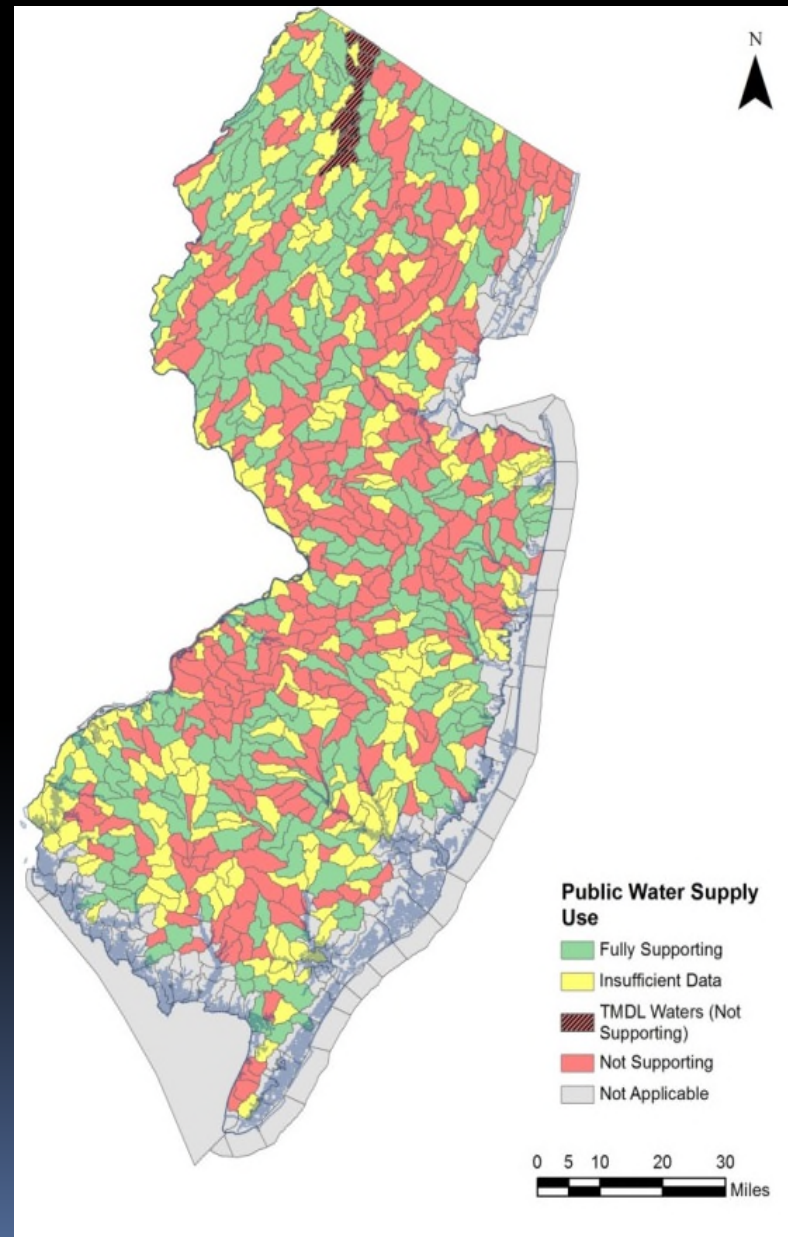
Assessment Unit Assessment

- Assessment Method
 - Comprehensive Assessment
- Station assessments rolled-up
- DDPLY
 - Preliminary AU level assessment
 - Number of stations, list of stations
 - Assessment results for each station
 - Trout/non-trout (DO, TEMP)
 - Number of samples for 5/10 yrs
 - Max/min values
 - Number of exceedances for 5/10 yrs
 - Metals – combines HH and AQL results
 - Compares to historical results and notes
 - Flags BPJ
- Incorporates TMDLs
- Create 303(d) List and other Sublist tables



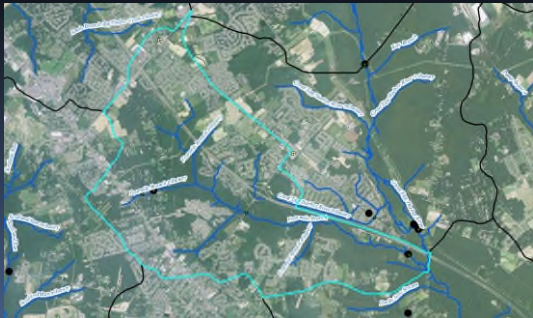
Designated Use Assessment

- Assessment Method
 - EPA independent applicability
- AU level assessment
- Assignment of parameters to designated use
- Aquatic Life Use (general and trout), Recreation, Water Supply, Shellfish Harvesting, Fish Consumption, Overall
- Compares historical results and notes
- Flags changes to previous assessment



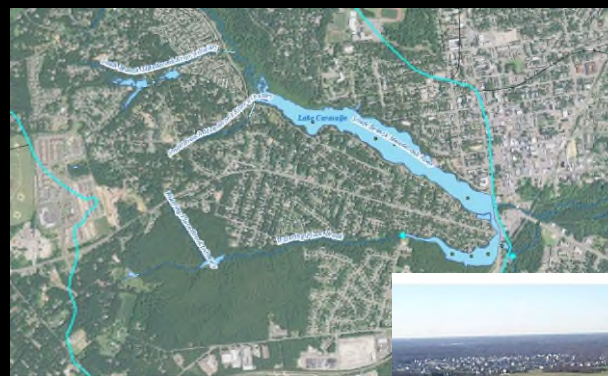
Comprehensive Assessment

- Water quality and biological data don't tell the whole story
- Comprehensive Assessment – what is it?
 - Team of Professionals– the more the better (need the right expertise)
 - Other lines of evidence need to be incorporated to get the “big” picture and validate results
 - GIS is the best tool available



Other Lines of Evidence

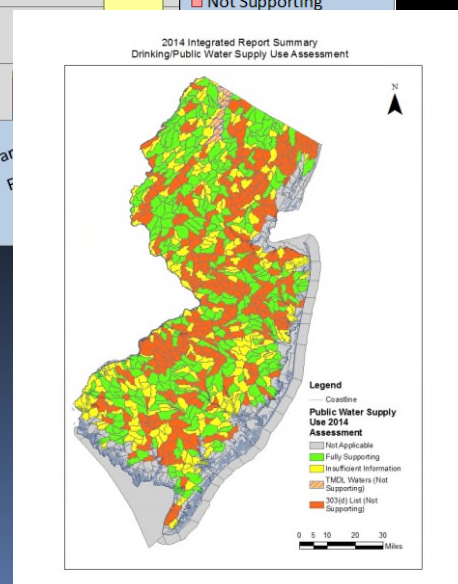
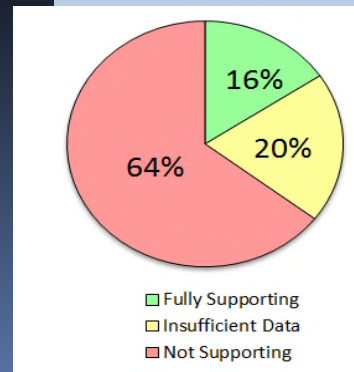
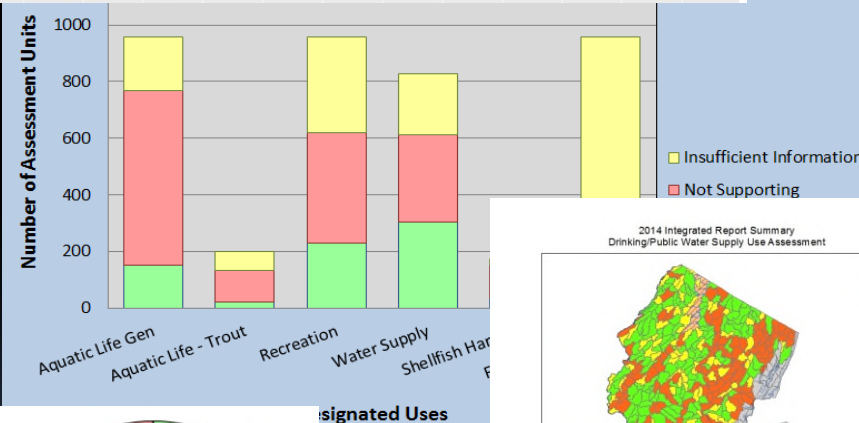
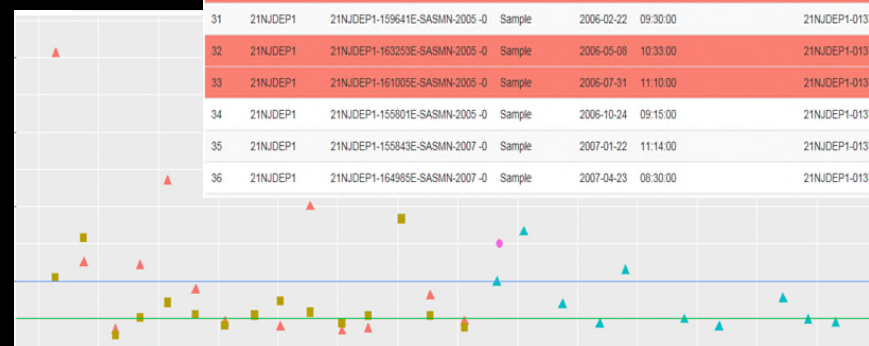
- Land use
- Hydrology
- Geology
- Point sources
- Nonpoint sources
- Aerial photography
- Groundwater contamination
- Weather information
- Biological habitat conditions
- Restoration activities



Assessment and Reporting Tools

- Assessment results compiled
- Pie charts, bar charts, maps for reports based on assessment results
- IRONMAN - Tool to plot and navigate through the assessment results

Organization ID	Activity ID	Activity Type	Date	Time	Activity Depth	Activity Depth Unit	Station Name	Activity Comment	Hydrological Condition
29	21NJDEP1-21NJDEP1-163763-SASMN-2005-0	Sample	2005-08-23	09:30:00			21NJDEP1-01378895		
30	21NJDEP1-21NJDEP1-156934-SASMN-2005-0	Sample	2005-11-17	09:20:00			21NJDEP1-01378895		
31	21NJDEP1-21NJDEP1-159641E-SASMN-2005-0	Sample	2006-02-22	09:30:00			21NJDEP1-01378895		
32	21NJDEP1-21NJDEP1-163253E-SASMN-2005-0	Sample	2006-05-08	10:33:00			21NJDEP1-01378895		
33	21NJDEP1-21NJDEP1-161005E-SASMN-2005-0	Sample	2006-07-31	11:10:00			21NJDEP1-01378895		
34	21NJDEP1-21NJDEP1-155801E-SASMN-2005-0	Sample	2006-10-24	09:15:00			21NJDEP1-01378895		
35	21NJDEP1-21NJDEP1-155843E-SASMN-2007-0	Sample	2007-01-22	11:14:00			21NJDEP1-01378895		
36	21NJDEP1-21NJDEP1-164955E-SASMN-2007-0	Sample	2007-04-23	08:30:00			21NJDEP1-01378895		



*Parameter Call

Total Phosphorus

Plot Criteria

streams lakes

Date Range

2005-01-01

to

2016-04-08

*HUC 14

HUC02030103010190

HUC02030103010060

New Location ID

ALL

Location ID

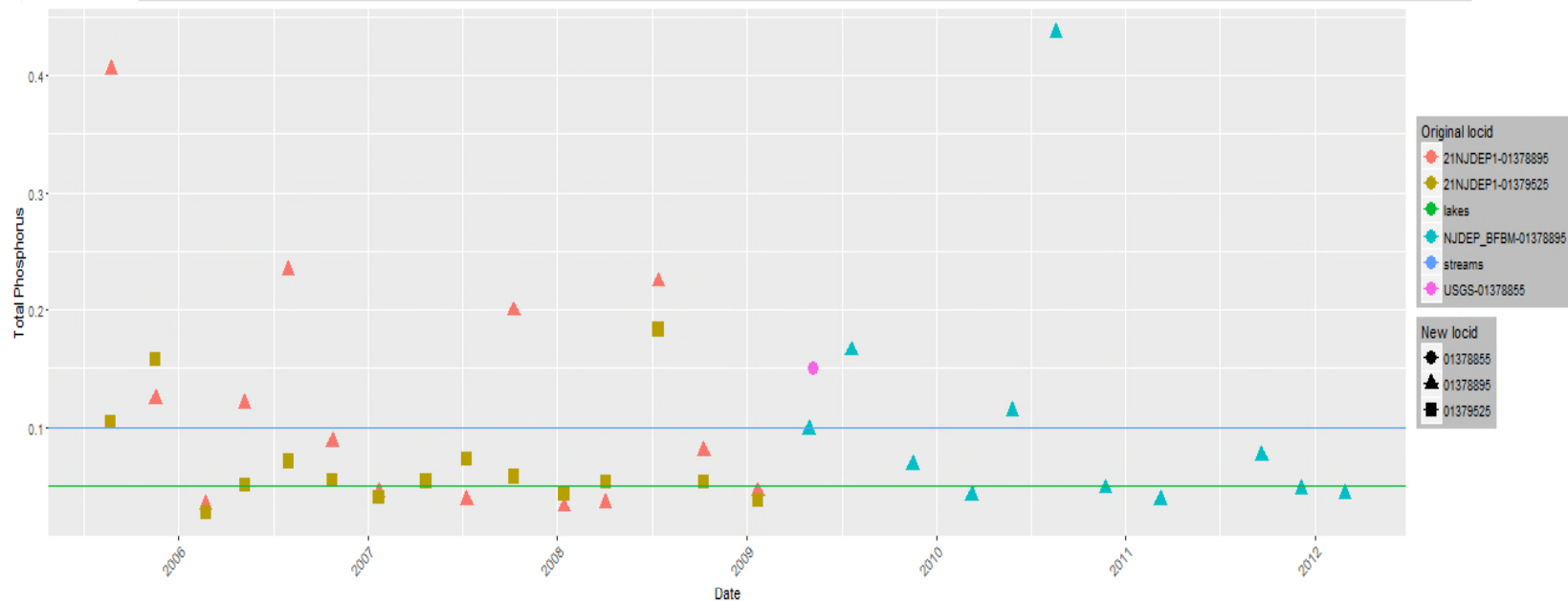
ALL

Dashboard

Station level Assessment

HUC level Assessment

Overall Assessment



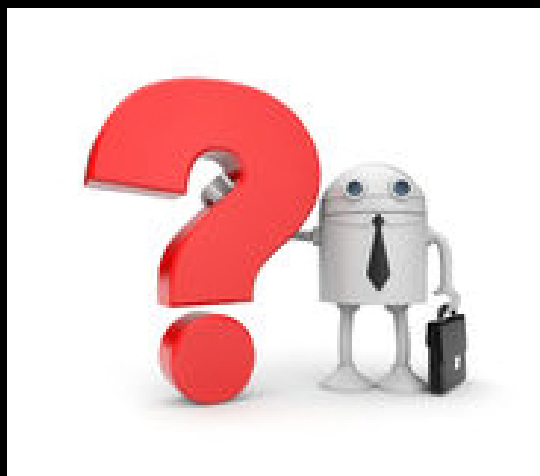
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	Organization ID	Activity ID	Activity Type	Date	Time	Activity Depth	Activity Depth Unit	Station Name	Activity Comment	Hydrology Condition
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31	21NJDEP1	21NJDEP1-159641E-SASMN-2005 -0	Sample	2006-02-22	09:30:00			21NJDEP1-01378895		
32	21NJDEP1	21NJDEP1-163253E-SASMN-2005 -0	Sample	2006-05-08	10:33:00			21NJDEP1-01378895		
33	21NJDEP1	21NJDEP1-161005E-SASMN-2005 -0	Sample	2006-07-31	11:10:00			21NJDEP1-01378895		
34	21NJDEP1	21NJDEP1-155801E-SASMN-2005 -0	Sample	2006-10-24	09:15:00			21NJDEP1-01378895		
35	21NJDEP1	21NJDEP1-155843E-SASMN-2007 -0	Sample	2007-01-22	11:14:00			21NJDEP1-01378895		
36	21NJDEP1	21NJDEP1-164985E-SASMN-2007 -0	Sample	2007-04-23	08:30:00			21NJDEP1-01378895		

Future Projects

- Automated data downloads
- Story Maps (NOT R) However...
- Link IRONMAN to Story Maps for public
- ATTAINS batch upload
- Trends
- Detecting threatened waters
- WQ27 AND WQ28 prioritization and tracking
- Restoration project effectiveness

Questions



Point of Contacts:

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Jack Pflaumer: (609) 633-0499 jack.pflaumer@dep.nj.gov

New Jersey Department of Environmental Protection
Division of Water Monitoring and Standards
Bureau of Environmental Analysis, Restoration, and Standards